

Constraints on Galactic populations of gamma-ray emitters from the unidentified EGRET sources

Jennifer Siegal-Gaskins

February 7, 2007

1st GLAST Symposium



Collaborators

Vasiliki Pavlidou

Carolyn Brown

Angela Olinto

Brian Fields

The EGRET Sky

All EGRET events ($E > 100$ MeV)

271 point sources + diffuse emission

unidentified sources (170)

blazars (66)

pulsars (5)

the LMC

solar flare (1)

radio galaxy (1)

'possible' blazars (27)

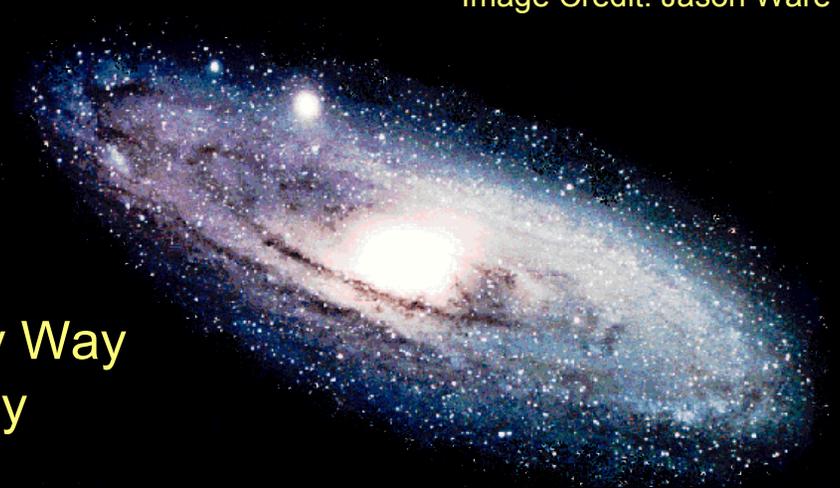
EGRET's Unidentified Sources

blazars } Known extragalactic source class

pulsars/PWN
supernova remnants
microquasars
etc. } Known Galactic source classes

annihilating dark matter clumps?
intermediate mass black holes? } Proposed Galactic source classes

A New Approach



Assume galaxies similar to the Milky Way host comparable populations of γ -ray sources

➔ Use M31 luminosity to place limits on the MW Galactic population!

$1.6 \times 10^{-8} \text{ cm}^{-2} \text{ s}^{-1}$ upper limit $F_{\text{M31}}(> 100 \text{ MeV})$ Blom et al. 1999

$-1.0 \times 10^{-8} \text{ cm}^{-2} \text{ s}^{-1}$ expected diffuse flux from CRs Pavlidou & Fields 2001

$0.6 \times 10^{-8} \text{ cm}^{-2} \text{ s}^{-1}$ expected upper limit on point source flux

Two Source Samples

from 3EG catalog

| Complete | Restricted |
|---|---|
| <ul style="list-style-type: none">- no 3EG ID- has P1234 flux <p>= 168 objects</p> | <ul style="list-style-type: none">- no 3EG ID- has P1234 flux- not 'possible' or 'likely' artifact- no recently suggested counterpart (even if tentative) <p>= 119 objects</p> |

Updated listing of suggested source identifications compiled by C. Brown:
http://home.uchicago.edu/~carolynb/unidentified_sources

The Luminosity Test

Assume unidentified source population follows MW mass distribution...

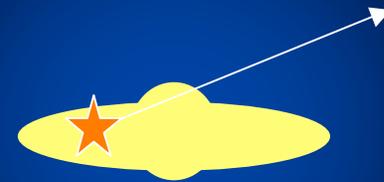
1) For each source:

- integrate mass along line of sight
- probability of distance \leftrightarrow integrated mass

2) Monte Carlo:

- assign a distance to each unidentified source
- calculate total luminosity for each realization

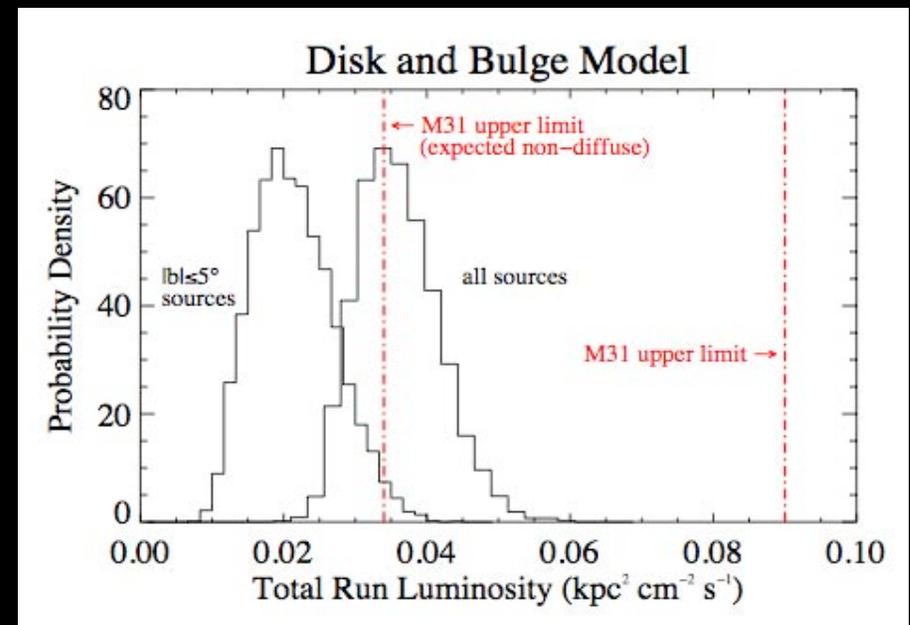
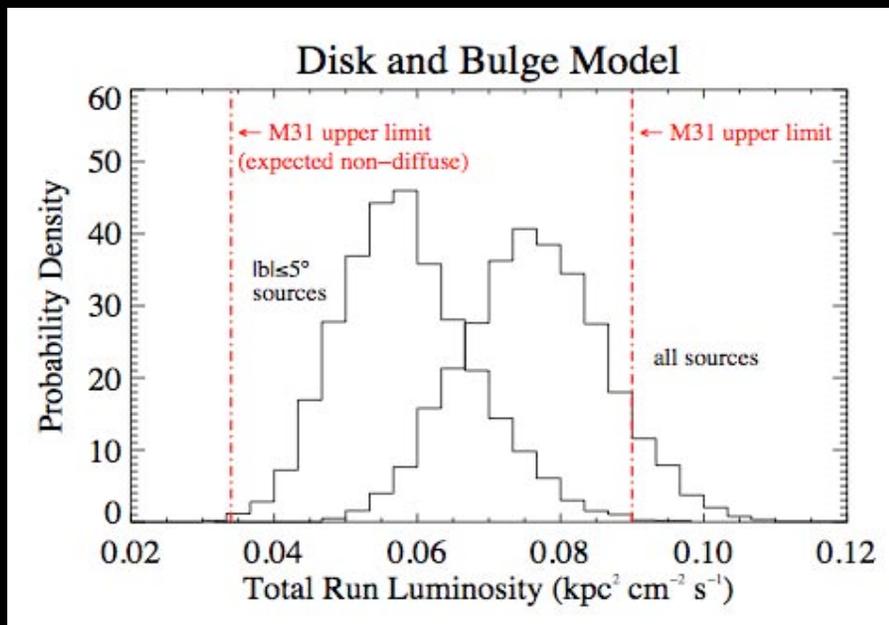
3) Compare total luminosities to the M31 limit



Results: Disk and Bulge Model

Complete Sample

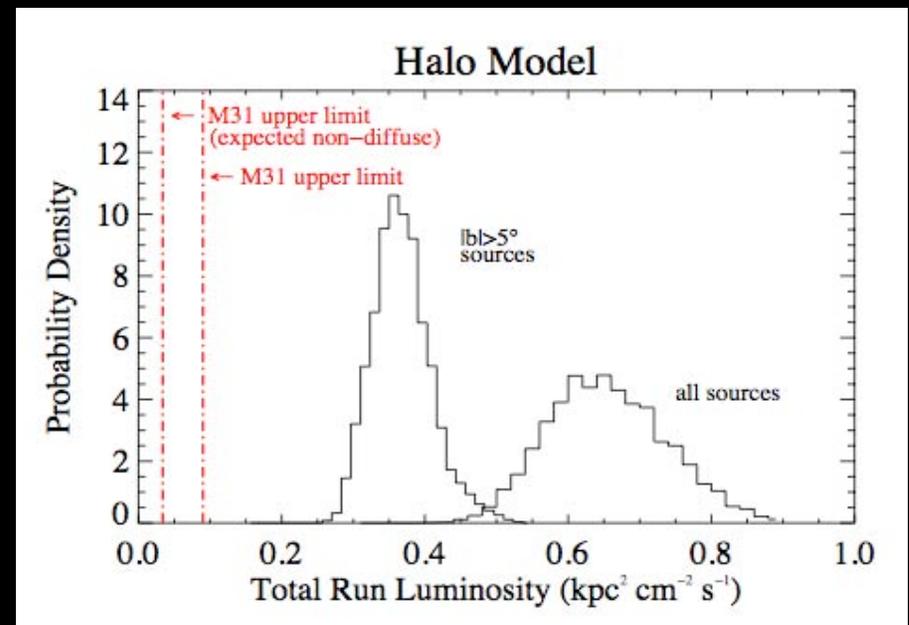
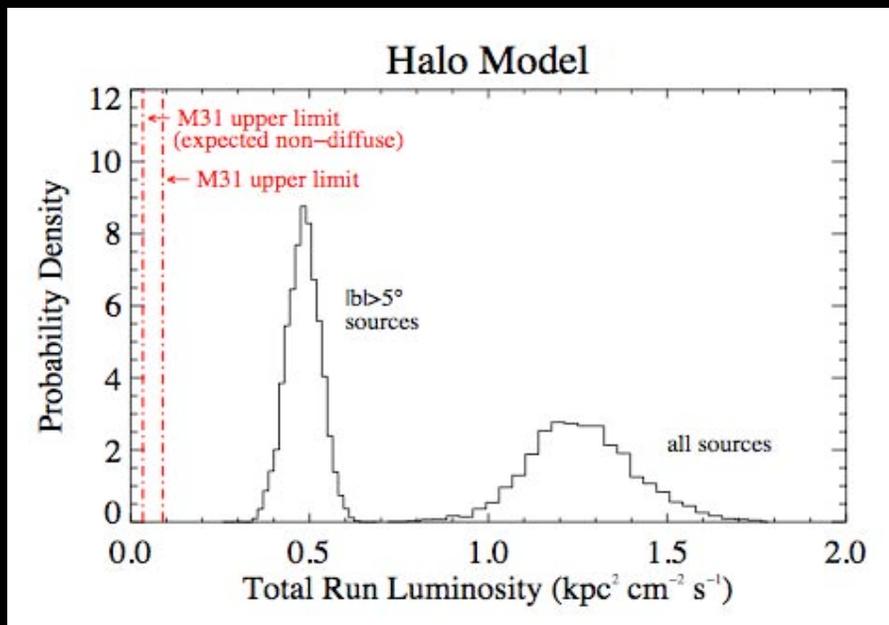
Restricted Sample



Results: Halo Model

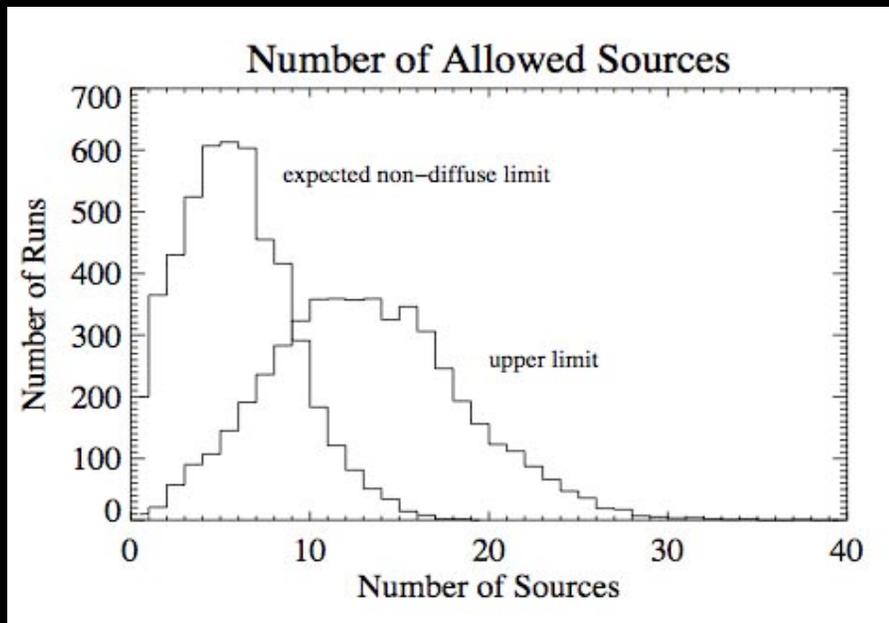
Complete Sample

Restricted Sample

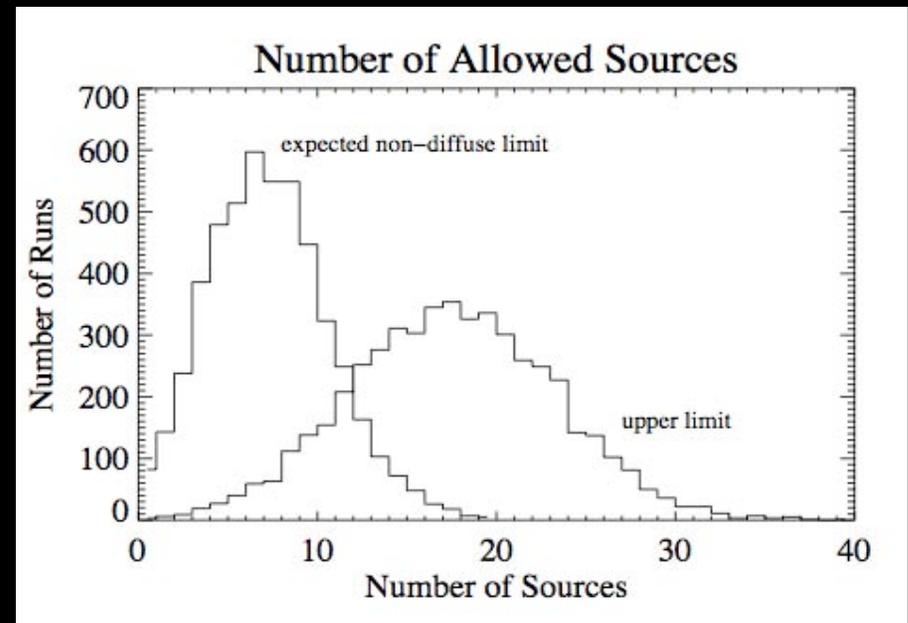


Halo sources: How many is too many?

Monte Carlo adding sources up to luminosity limit



Complete Sample

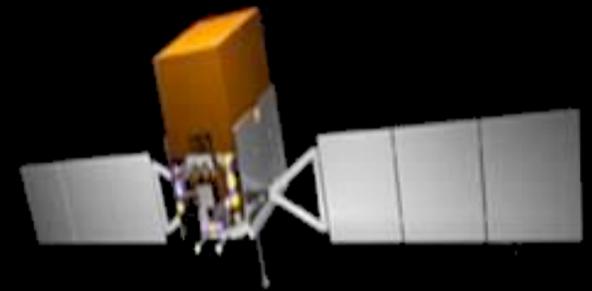


Restricted Sample

GLAST

New constraints on Galactic populations

- M31 detection
 - test assumption that M31 similar to MW in gamma-rays
 - stronger constraint on luminosity limit + lower bound?
- more sources = better isotropy tests
 - help distinguish Galactic/EG populations
- reduced backgrounds
 - determine origin (Galactic/EG) of newly resolved sources



Summary

- Unidentified source populations:
 - very few can be in halo
 - could all be disk/bulge sources
 - could be extragalactic (e.g. blazars)
- GLAST will:
 - test whether M31 is similar to the MW in gamma-rays
 - place stricter limits on the distribution of the unidentified sources
 - better determine the G and EG backgrounds and possibly determine the origin of the unresolved source component